Space Weather Technical Forecast

Issued on Friday, 28 June 2024 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares throughout. G1-G2 Minor-Moderate Storm intervals likely days 1-2 (28-29 Jun) due to recent CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with occasional low level C-class flares. The peak flare was a C6.6 observed at 27/2347 UTC. There are currently eleven regions on the visible disc, with the previously elongated and complex AR3723 now reanalysed as two separate regions and subsequently re-classified, with the new AR3730 constituting the previous leading portion of that group. AR3729 is now the most complex single region, located in the southeast quadrant. All remaining sunspots on the disc are showing only very slow evolution and appear to be stable.
A recent 'shock' was observed at 28/0905 UTC arriving at L1, which is most likely the arrival of a CME which left the Sun on the 25 June, which was associated with a filament eruption off the southwest quadrant.

No other Earth-directed CMEs have been observed in coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed by ACE/DSCOVR at L1, were at background, between 320-350 km/s, until the arrival of a CME at L1 (probably associated with the CME which left the Sun on 25 June) with speeds increasing to slightly elevated levels, currently near 420km/s. Density was average to above average throughout. The Interplanetary Magnetic Field, Bt, was persistently moderate, increasing to strong, with a peak of 30nT observed at 28/1035 UTC, due to the arrival of aforementioned CME. The all-important Bz component, was persistently negative (southward) orientated and mostly weak to moderate throughout, before increasing to strong, with a peak of -25nT observed at 28/1035 UTC, due to the CME arrival. However, no strong deflection was observed at Hartland' magnetometer. Phi angle was predominately negative (towards the Sun). Geomagnetic activity was initially Quiet (Kp 2), but increased to Unsettled to Active (Kp3-4), with a G1/Minor storm interval observed at 28/0900-1200 UTC following the arrival of the CME.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The 24-hour fluence remained below Active, with 1.08e6 integrated pfu observed at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity:
A CME which left the Sun on 23 June may have given a weak enhancement overnight. A further CME, which left the Sun on the 25 June, is probably the likely candidate for the recent arrival at Earth, which is slightly earlier than anticipated. Solar winds are expected to be slightly elevated

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due to the recent CME arrival, just above 450km/s. Solar winds should gradually reduce to background levels during day 2 (29 June) and are expected to remain so throughout the remainder of the period, with no CHs on disc, therefore no fast wind enhancements are expected. A CME which left the Sun on 27 June may give a slight chance of a glancing blow on day 4 (01 June) but this is low confidence.

Geomagnetic activity is expected to be Unsettled to Active (Kp3-4) with a Chance of G1-G2/Minor-Moderate Storm interval, following the recent CME arrival, day 1 (28 June), before gradually waning day 2 (29 June). Becoming mostly Quiet to Unsettled day 3 (30 June), with a chance of Active (Kp 4) and a slight chance of G1/Minor Storm interval by day 4 (01 July) due to a possible glancing blow from a CME, which left the Sun on 27 June.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur from the numerous sunspots that currently occupy the visible disc. High energy electron flux is forecast to be at background. The associated 24-hour fluence is expected to remain well below the Active threshold.

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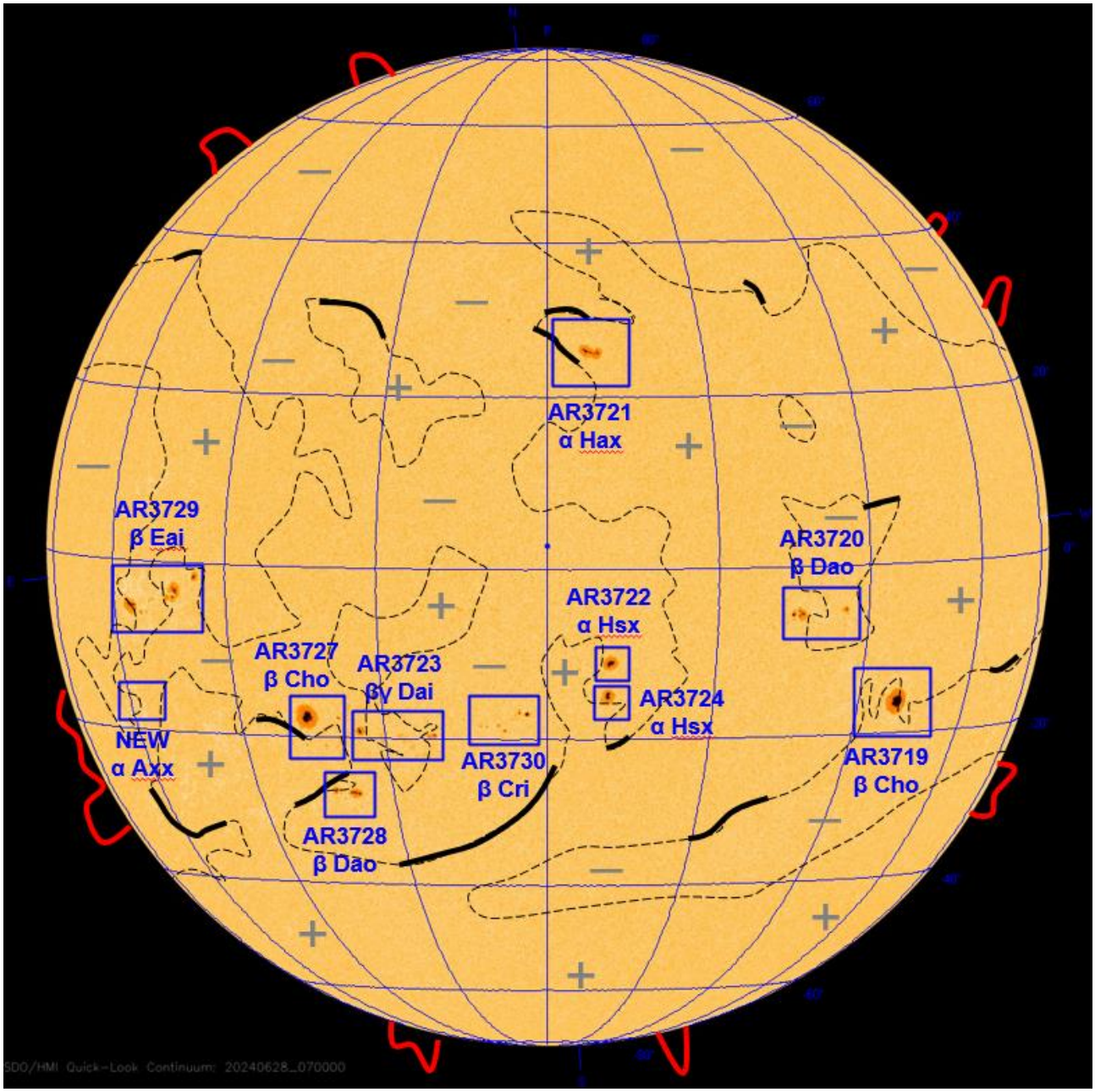
Figure 1. Solar Analysis Valid 28/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on 23 June may have given a weak enhancement overnight. However, another CME, which left the Sun on the 25 June, associated with a filament eruption off the southwest quadrant, is probably the likely candidate for the recent arrival at Earth. Solar winds are expected to be slightly elevated, just above 450km/s during day 1 (28 June). Solar winds should gradually reduce to background levels during day 2 (29 June) and are expected to remain so throughout the remainder of the period, with no CHs on disc, therefore no fast wind enhancements. A CME which left the Sun on 27 June may give a slight chance of a glancing blow on day 4 (01 June) but this is low confidence.

Geomagnetic activity is expected to be Unsettled to Active (Kp3-4) with a Chance of G1-G2/Minor-Moderate Storm interval, following the recent CME arrival, day 1 (28 June), before gradually waning day 2 (29 June). Becoming mostly Quiet to Unsettled day 3 (30 June), with a chance of Active (Kp 4) and a slight chance of G1/Minor Storm (Kp5) interval on day 4 (01 July) due to a possible glancing blow from a CME, which left the Sun on 27 June.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	70	50	20	10
Strong	G3	No	10	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/1527	Partial	Filament	SW	446 km/s	28/2100 +/- 6hrs	Arrived earlier than expected – currently ongoing
26/0701	Partial	C3.9 AR3720 + Filament	S-Centre	400 km/s	29/1400 +12/-6hrs	Only weak impact likely

Figure 2: L1 (ACE) observed data shows the arrival of the CME early on 28 June. This was probably the CME which left the Sun on the 25 June due to a large filament eruption off the SW quadrant.

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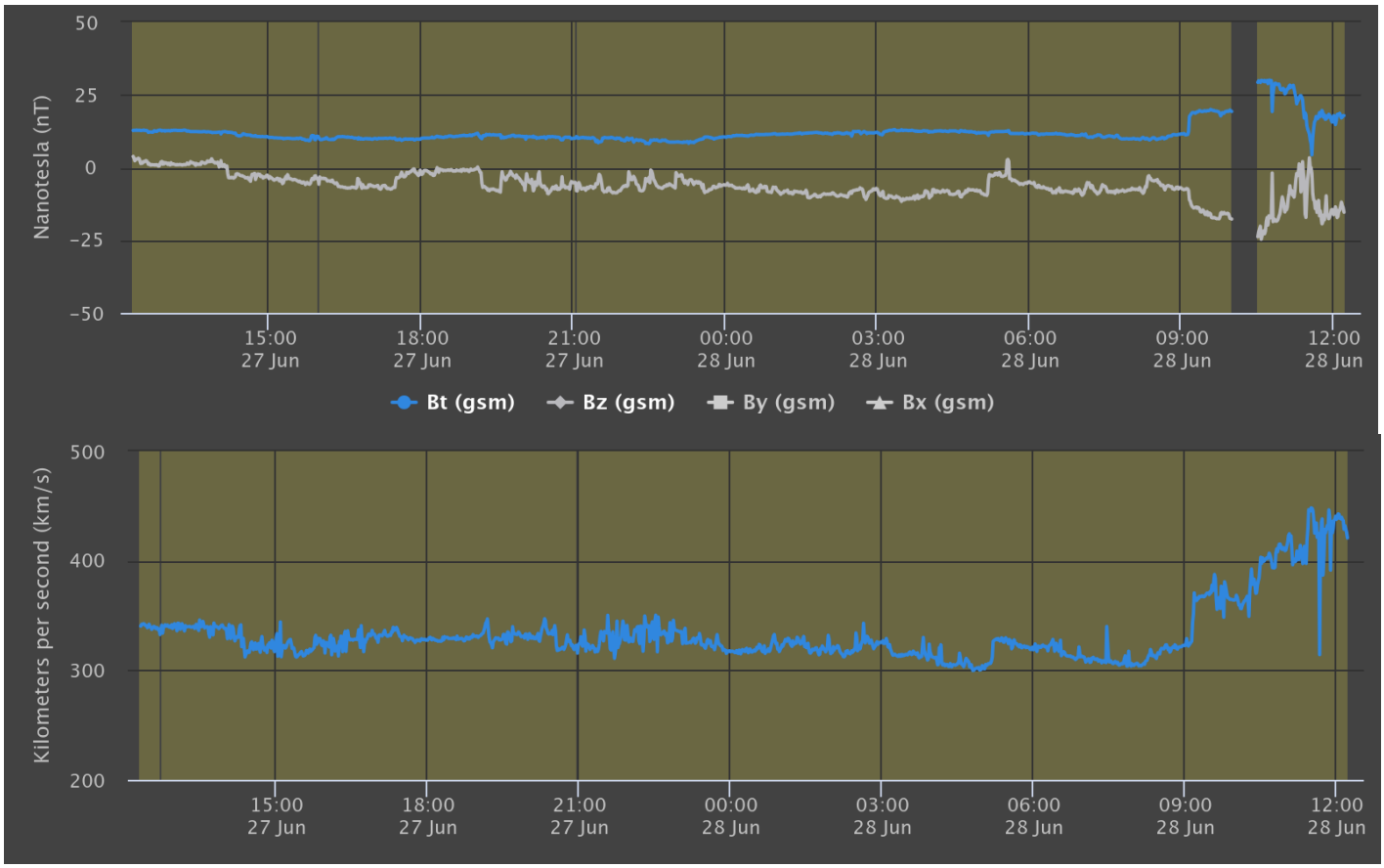

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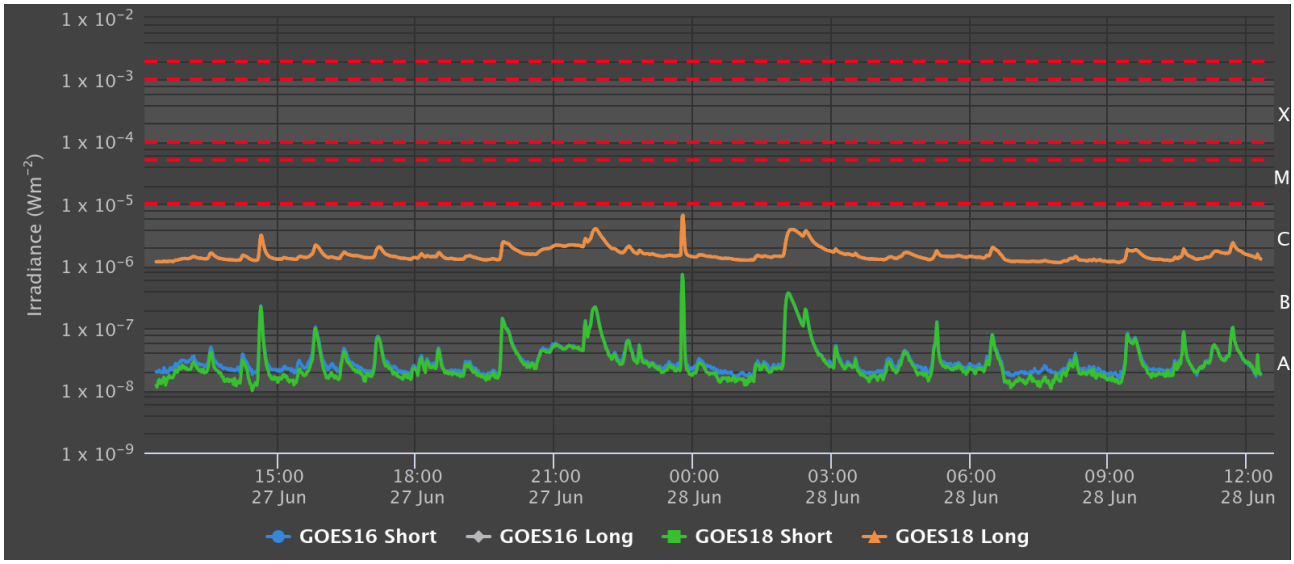
Radio Blackouts - X-Ray Flares:
There are currently eleven regions on the disc, with the previously elongated and complex AR3723 now reanalysed as two separate regions and subsequently re-classified, with the new AR3730 constituting the previous leading portion of the group. AR3729 is now the most complex single region, located in the southeast quadrant. All remaining sunspots on the disc are showing very slow evolution and appear stable.

Far side sounding data and persistence suggest the potential for one or more regions to rotate around the eastern limb during the period and all current main flare risk regions remain on the visible disk throughout. Therefore an ongoing daily chance of isolated M-class flares is maintained pending further developments, with a slight chance of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES X-Ray flare trace.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as measured by GOES-18, is expected to remain at background. The numerous sunspots on the Earth-facing are either away from the better connected west limb, or relatively simple and stable, so thought unlikely to produce significant flares that would lead to the observed proton flux at GOES rising.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is expected to remain at generally background levels. With no notable sources of enhancement forecast.

Associated electron fluence is expected to persist well below the Active threshold (1e8 integrated pfu), with MOSWOC REFM output considered to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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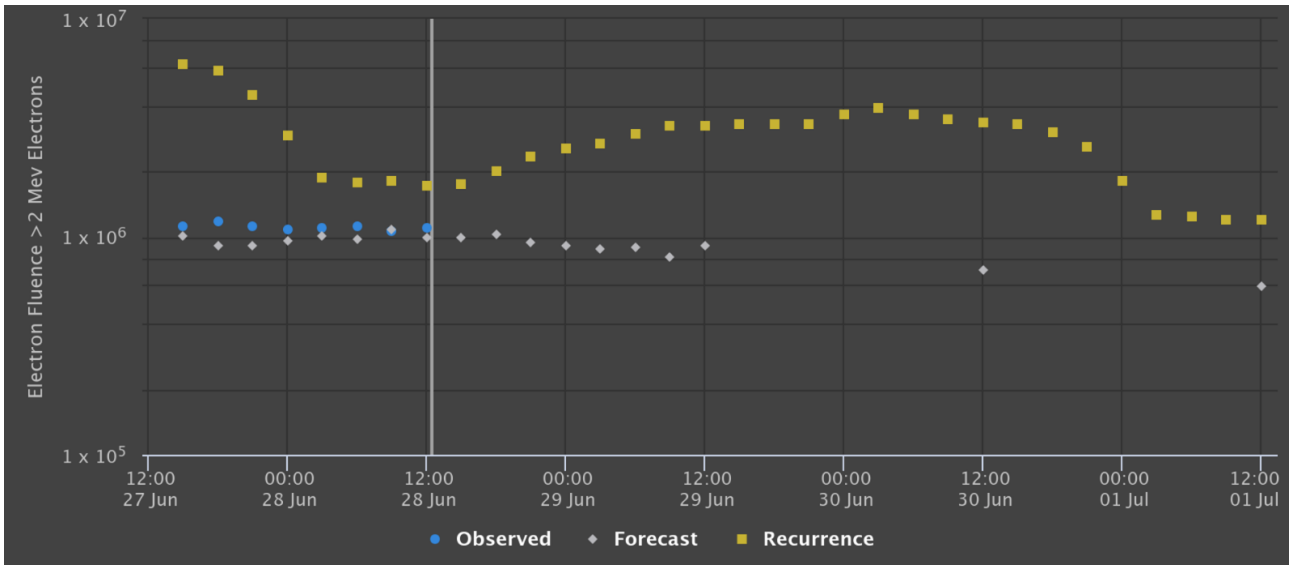
Figure 4: MOSWOC Electron Fluence



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